

### **REMARKS**

Applicants request reconsideration of the application as amended. Claims 37-52 are pending. Claims 37, 39 to 42, 44 to 46, 48, 49, 51 and 52 are amended for form and clarity to place the claims in better condition for appeal. Claims 1-36 were previously canceled.

### **Information Disclosure Statement**

Applicants provide a complete copy of the information disclosure statement filed February 16, 2006, along with a copy of JP 04-021536 (Hitachi Cable), the prior copy of which the Examiner previously indicated had not been legible. Consideration of the information disclosure statement is respectfully requested.

### **Claim Amendments and Rejection under 35 USC 112, first paragraph.**

Claims 37 to 51 were rejected under 35 USC 112, first paragraph as lacking written description for the claim term “downstream of the nozzle”. Applicants have amended the claims to delete this term. Applicants have further amended these claims to make clear that the flame is formed outside of the nozzle, as is shown in FIG. 1. The fuel gas and oxygen are emitted from the nozzle (8) at the nozzle front face and ignited to form the flame (9) outside of the nozzle.

Claims 37 to 51 were further amended to make clear that the first and second glass components react to form the first and second oxide particles “in the flame”. This language is supported by the specification inter alia at page 5, lines 6 to 16: “The precise process of the reactive formation *in the flame*. . . . The formed particles react either simultaneously or separately with the above-mentioned reactions and combine with each other to form homogeneous multicomponent glass. The produced multicomponent glass particles are guided by means of the flame 9 onto the surface of a target 10, . . . .”

Claims 39, 40, 42, 45, 48, 49 and 52 were amended to add “(a)”, “(b)” and “(c)” to separate the elements identified for better clarity.

No new matter has been added.

For clarification, in the present application, FIGs. 1 and 2 are schematic illustrations as permitted under applicable US PTO drawing rules. MPEP §608.02(d). FIG. 1 shows only that portion of the spray gun (1) relevant to the method that is being claimed. That portion comprises the nozzle (8), the plurality of tubes ((2a), (3a), (4a), (5a), and 6(a)) through such nozzle (8), the feed tubes ((2), (3), (4), (5), and (6)) leading into the nozzle (8), and an injection pump (7). Nozzle (8) terminates at a front nozzle face (see FIG. 2), which is the vicinity of where the flame (9) is formed outside of the nozzle (8). The nozzle (8), with multiple tubes terminating in multiple exit orifices at the front nozzle face, comprises one component of the spray gun (1). In FIG. 1, the lead line for spray gun (1) points to (but does not contact) the same portion of the structure that comprises the nozzle (8). In the context of the application specification the spray gun (1) is not limited to the plurality of tubes ((2a), (3a), (4a), (5a), and 6(a)) through the structure that comprises nozzle (8).

In the present application, applicants have used the term “nozzle” consistent with the ordinary meaning of this term: “a short tube with a taper or constriction used (as on a hose) to speed up or direct a flow of fluid” – the definition identified by the Examiner. By passing through the plurality of tubes ((2a), (3a), (4a), (5a), and 6(a)) through such nozzle (8), the various component liquids, gases and/or vapors (all “fluids”) are directed to the vicinity of the flame (9). Thus, the nozzle (8) comprises the structure through which the plurality of tubes ((2a), (3a), (4a), (5a), and 6(a)) direct the liquids and gases as specified in the pending claims. The application specification supports this meaning of “nozzle”:

FIG. 1 shows nozzle (8) where the lead line points to the exit face or front face of the nozzle, which front face is depicted in FIG. 2;

In FIG. 1, gas ducts (2), (3), (4) and (5) are shown outside of nozzle (8);

At page 4, line 32, gas tube (2a) is "*in* the nozzle 8";

At page 4, lines 11-14, the feeding components are "via a common nozzle 8";

At page 5, line 34 to page 6, line 4, the gases flowing in tubes 2a to 4a are flowing "*through* the nozzle 8"; and

At page 5, lines 5-6: "*After* the nozzle 8, hydrogen and oxygen react to form a flame 9."

#### **Claim Rejections - 35 U.S.C. §103**

##### ***Rejection of Claims 37, 38 and 41 Based on Hawtof and Takahashi***

Applicants respectfully request reconsideration and withdrawal of the rejection of claims 37, 38 and 41 under 35 U.S.C. §103(a) as being unpatentable over Hawtof (US 6,565,823) in view of Takahashi (US 4,388,098).

Applicants note that, to establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art references must teach or suggest all the claim limitations.<sup>1</sup> Further, the teaching or suggestion to make the

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<sup>1</sup> See MPEP §2143.

claimed combination and the reasonable expectation of success must both be found in the prior art, not in applicant's disclosure.<sup>2</sup>

Claim 37 is directed to a method for forming multicomponent glass particles in a flame and spraying the glass particles to a target. This method includes *inter alia* the following steps (emphasis added):

introducing a first glass component through the nozzle to the flame such that the first glass component reacts in the flame to form first oxide particles, wherein the first glass component consists of a gaseous or vaporous substance;

introducing a second glass component through the nozzle to a vicinity of the flame, wherein the second glass component comprises a liquid solution containing a rare earth metal;

introducing an atomizing gas through the nozzle to the vicinity of the flame, and atomizing the second glass component with the atomizing gas in the vicinity of the flame so as to form second oxide particles in the flame; and

wherein the first oxide particles and the second oxide particles combine with each other in the flame so as to form multicomponent glass particles comprising the rare earth metal.

Thus, in claim 37, a first glass component is introduced to the flame in gas or vapor form and a second glass component, including a rare earth metal, is introduced in an atomized liquid form. There are two separate feedstocks introduced through different orifices in the nozzle and come together at the flame.

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<sup>2</sup> *In re Vaack*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991) and *See* MPEP §2143.

The separate glass feedstocks are important to the applicants' invention. When making their invention, the applicants observed that their first glass component, usually  $\text{SiCl}_4$ , tended to react more slowly with oxygen than did rare earth metals. As a consequence, dopant particles would accumulate into the core of multicomponent glass particles, while silicon oxide particles placed themselves on the outside (or formed a clad layer over the dopant particles). In the claimed invention, applicants produce more homogeneous multicomponent glass particles by atomizing the liquid glass component that incorporates a dopant component in the vicinity of the flame, in combination with introducing a separate gaseous glass component to the flame. There is better mixing in the flame in this flame hydrolysis method. This prevents sequential deposits of different components.

Referring to FIG. 1 in Hawtof and the accompanying text, Hawtof discloses a method for forming fused silica glass. A liquid reactant (halide-free silicon-containing compound, e.g., siloxane feedstock) is delivered to a combustion burner 10. A dopant compound, which may be a metal oxide of a rare earth metal (Col. 7, lines 3-6), optionally is added to the liquid reactant either in the liquid feed tank 11 or at the liquid injector 15. The liquid reactant is atomized as it is introduced to the flame at the burner. Referring to FIG. 4 showing a preferred embodiment in Hawtof, an airblast atomizer directs high velocity inert gas, such as nitrogen, into the liquid reactant feedstock to produce the finely atomized liquid reactant particles that are introduced to the flame.

Hawtof does not carry out the method claimed in claim 37 because Hawtof does not introduce a first glass component in a gaseous or vaporous substance that is separate from a second glass component that is an atomized liquid solution containing a rare earth metal. Hawtof introduces only the one atomized liquid stream that optionally may contain a rare earth metal oxide.

Applicants respectfully disagree with the Examiner's expansive reading of Hawtof. Hawtof at all times intends to introduce the siloxane feedstock *in liquid form*. That liquid may be atomized, but it is not intended to be in vapor form. Hawtof hedges

his bets by noting that the “liquid” siloxane feedstock could include a small portion (unintended) of vapor as delivered to the burner combustion site. Skilled persons reading the complete Hawtof disclosure in context would understand that Hawtof directs them to use a siloxane feedstock in liquid form, not vapor form. Moreover, Hawtof does not direct use of two glass feedstocks -- a separate glass feedstock in liquid form with a rare earth metal and a separate glass feedstock in vapor form, as is required in pending claim 37. Hawtof has only the one liquid feedstock, which is directed to the flame through atomizer 31 (FIG. 2) or atomizer 41 (FIG. 4). No separate vapor feedstock to the burner flame is shown.

Applicants submit that the Examiner’s interpretation of Col. 7, lines 36 to 44 of Hawtof is objectively unreasonable. At Col. 7, lines 36 to 44, Hawtof states:

We generally refer in the discussion to the reactant as being in “liquid” form. What we mean by that expression is that the reactant is in substantially liquid state. Some small portion of the reactant may be in vapor form, particularly where preheater 14 is employed, or where a nitrogen blanket over the liquid is employed. A small portion of the reactant can be in vapor form as delivered to the combustion site without adversely affecting the operation of the invention.

By this passage, Hawtof does not encourage a skilled person to introduce two glass feedstocks to a burner, with one in liquid form and one in vapor form. Hawtof repeatedly notes that vapor feedstock introduction is to be avoided, and only teaches introducing a single liquid feedstock.

In the Background section of the Hawtof patent, Hawtof identifies the problems associated with prior processes using “vaporous reactants”. The feedstock solutions with high vapor pressures that made them “vaporous reactants” also had drawbacks -- detrimental by-products were formed, such as hydrochloric acid, and particulate

pollutants were generated. (Col. 1, line 16 to Col. 2, line 10). Hawtof further notes that use of “vaporous reactants” leads to imperfections and unusable end products:

Applicants have found that, in the course of delivering a vaporized polyalkylsiloxane feedstock to the burner, high molecular weight species can be deposited as a gel in the line carrying the vaporous reactants to the burner or within the burner itself. This leads to a reduction in the deposition rate of the soot preform that is subsequently consolidated to a blank from which an optical waveguide fiber is drawn. It also leads to imperfections in the blank that will produce defective or unusable optical waveguide fiber from the affected portions of the blank (Col. 4, lines 21-30).

Hawtof wished to avoid these drawbacks of vaporous reactants. Thus, when confronted with this teaching in Hawtof, persons of ordinary skill in the art would not have been lead to introduce a separate vapor or gas feedstock to a burner. Quite to the contrary, Hawtof teaches the skilled person to use only a single liquid feedstock, and identifies the many problems that Hawtof indicated can be avoided as compared with systems that used vapor feedstocks.

Takahashi does not fill this significant gap in the disclosure of Hawtof. Referring to FIGs. 3 and 4 and the accompanying text of Takahashi, a multi-conduit burner 31 introduces a gaseous glass raw material (such as  $\text{SiCl}_4$  carried by argon gas) through one conduit, and a nebulized metal salt solution through another conduit, as well as fuel (e.g. hydrogen) and oxygen gases through other conduits. Takahashi does not combine a separate gas or vapor glass feedstock with a liquid glass component feedstock that includes a rare earth metal. Takahashi has a separate dopant solution devoid of glass component.

Persons of skill would not be disposed to combine Hawtof and Takahashi, because these two references seek to solve the problem of creating multicomponent glass

particles in different ways. Takahashi represents a "vaporous reactants" type flame hydrolysis system that caused the drawbacks identified by Hawtof. Hawtof expressly seeks an entirely liquid feedstock system and Takahashi uses a gaseous or vaporous feedstock system. Takahashi atomizes or nebulizes a dopant solution, but such solution is not a glass component solution.

In addition, Takahashi starts with glass raw material that includes halide, such as  $\text{SiCl}_4$ ,  $\text{GeCl}_4$ ,  $\text{POCl}_3$  and  $\text{BBr}_3$ . Hawtof expressly avoids halide containing glass materials, preferring siloxanes, because Hawtof wants to avoid forming HCl (see, e.g., Hawtof at Col. 1, line 65 to Col. 2, line 22). Thus one skilled in the art would not readily combine these references that start with different raw materials and feed these different raw materials to a flame in different forms.

Still further, there would be no reasonable expectation of success from combining the disclosures of Hawtof and Takahashi as suggested by the Examiner. Hawtof states that "... burner 40 incorporates within its structure atomizer 41, which injects very finely atomized liquid reactant particles into flame 23." *Hawtof*, Col. 8, lines 21-24. Hawtof explains that the liquid reactant might contain a small portion of vapor because the liquid feedstock has been vaporized due to heating or other reasons. Unlike the claimed invention, in Hawtof the vaporized portion and the liquid portion are introduced in the flame through the same channel, and as a result it is not possible to adjust the liquid and vapor portions separately, therefore making it impossible to find a workable temperature for the process. Furthermore, in Hawtof, both the vapor portion and the liquid portion are atomized when they exit the channel, whereas in the inventive process, only the liquid component is atomized. Based on these discrepancies between Hawtof and the claimed invention one would not expect to have success in combining the Hawtof and Takahashi references to arrive at the claimed process.

Claims 38 and 41 depend from claim 37, and are patentable for the same reasons claim 37 is patentable. For at least the above reasons, claims 37, 38 and 41 are allowable over the combination of Hawtof and Takahashi.



### **Rejection of Claims 39 and 40 Based on Hawtof, Takahashi and Ainslie**

Applicant respectfully requests reconsideration and withdrawal of the rejection of claims 39 and 40 under 35 U.S.C. §103(a) as being unpatentable over Hawtof and Takahashi, as applied to claims 37 and 38, and further in view of Ainslie (US 4923,279).

Claims 39 and 40 depend from claim 37. Claims 39 and 40 are directed to specific embodiments in which the first glass component is silicon or germanium tetrachloride and the second glass component contains erbium nitrate, water or alcohol and aluminum. The first glass component thus is a halide-containing glass component.

Hawtof and Takahashi fail to render the method of claim 37 obvious for the reasons provided above. In addition, Hawtof specifically directs skilled persons away from using halide-containing silicon-containing compounds, such as silicon tetrachloride. (Col. 1, lines 60-64). These compounds produce undesirable hydrochloric acid by-product (Col. 1, line 65 to Col. 2, line 6). Hawtof expressly prefers "halide-free, silicon containing compounds", such as siloxanes (Col. 2, lines 34-35; Col. 6, lines 57-65). In claims 39 and 40, the first glass component is expressly a substance that Hawtof teaches to avoid (a chloride). This is another reason that claims 39 and 40 distinguish over the attempted combination of Hawtof and Takahashi.

Ainslie does not supply the elements and motivation missing from Hawtof and Takahashi. First, Ainslie does not teach that problems Hawtof associated with halide-containing glass components can be overcome in a flame hydrolysis method. Ainslie does not concern flame hydrolysis at all. Ainslie does not use a concentric nozzle burner that introduces separate glass components in atomized and gaseous or vaporous forms to a flame. Instead, Ainslie uses an inside deposition process called modified chemical vapor deposition (MCVD). With MCVD, layers of glass are deposited inside a tube, while the tube is heated from the outside. There is no mixing within a flame, and the feed gases are not introduced through a nozzle to a flame.

Ainslie expressly wants to have glass fibers with an inner core that includes dopant material surrounded by a cladding of different composition. Ainslie is not looking to make a homogeneous multicomponent glass particle, as is the aim of the methods claimed in claims 39 and 40. Ainslie “requires a high concentration of dopant at the axis” of the optical fiber (Col. 3, lines 8-9). To achieve this high concentration of dopant at the axis or core, Ainslie first uses MCVD to create various glass layers inside a tube. Then, the last porous glass layer formed by MCVD on the inside of the tube is doped with a rare earth metal (such as Er) by immersing the tube with the porous glass layer in a rare earth solution (containing  $\text{Al}(\text{NO}_3)_3$  and  $\text{ErCl}_3$ ) for one hour, after which the doped material is separately heated to evaporate the solvent.

Skilled persons would not be disposed to combine Ainslie’s teachings -- concerning rare earth metal doping (using erbium chloride – not erbium nitrate) by soaking the porous glass in a liquid solution after MCVD -- with the gas burner flame glass particle methods of Hawtof and Takahashi. The MCVD technique is completely different and has nothing to do with methods for spraying glass particles to a target. Applicants discovered specific methods for forming multicomponent glass particles by spraying the glass particles to a target. In the claimed methods, the doping occurs as the components are reacted in the flame. There is no soaking solution or soaking time. A reference that concerns doping by soaking cannot translate to a method where doping occurs in a flame reaction. The Examiner could find no teaching of erbium nitrate as a doping material in Hawtof and Takahashi. But the Examiner cannot properly pick and choose disparate teachings from a separate unrelated reference like Ainslie without regard to whether skilled persons would be motivated to combine such teachings.

Ainslie shows that erbium chloride can be doped into  $\text{SiO}_2$  formed by an MCVD process using  $\text{SiCl}_4$  and other glass components by an immersion method. Ainslie does not use a flame method. So, Ainslie does not teach or suggest anything with respect to whether flame sprayed glass particles can be doped with erbium or other rare earth metals. The relevant inquiry is not only whether a skilled artisan would gather from

Ainslie that the particular rare earth metals would be beneficial in resultant glass fibers, as the Examiner has asserted, but also whether a skilled artisan having read Ainslie would have gathered that one could successfully apply those rare earth metals in a flame mixing method as claimed in claims 39 and 40. Ainslie provides no suggestion to apply the particular rare earth metals in such claimed methods. These methods patentably distinguish from Hawtof, Takahashi and Ainslie.

Still further, applicants have submitted evidence (in the 37 C.F.R. §1.132 Declaration of Simo Tammela dated May 4, 2005 - filed in the Amendment in response to the Office Action dated April 21, 2005) that shows erbium doped glass fibers made by the claimed method have improvement in peak absorption and cut off wavelength over erbium doped glass fibers made using an MCVD method. This evidence rebuts any assertion that erbium doping by an MCVD method could be directly translated to a flame hydrolysis method such as claimed by the present applicants. Erbium doping efficiency and homogeneity is different in these methods.

For at the above reasons, claims 39 and 40 are allowable over the combination of Hawtof, Takahashi and Ainslie.

***Rejection of claims 37-45 based on Randall, Hawtof, Ainslie and Takahashi***

Applicants respectfully request reconsideration and withdrawal of the rejection of claims 37-45 under 35 U.S.C. §103(a) as being unpatentable over Randall (US 3883336) in view of Hawtof, Ainslie and Takahashi.

Independent claims 37, 42 and 44 all require that fuel gas, a first glass component in gas or vapor form, a second glass component in liquid form that contains a rare earth metal, and an atomizing gas are all introduced through the same multi-conduit nozzle to a flame. In contrast, Randall shows a separate nebulizer directing a solution of dopant to the flame of a flame hydrolysis system burner. The separate nebulizer does not pass the liquid and atomizing gas through the same nozzle that directs the fuel gas and first glass

component ( $\text{SiCl}_4$  in the Figure in Randall) to the flame. Nor does Randall include a second glass component that incorporates a rare earth metal.

In contrast to the claimed invention as set forth in claims 37-45, Randall does not:

- a) disclose introducing a second glass component through the nozzle to the vicinity of the flame;
- b) mention rare earth metals and a solution containing a rare earth ion, water or alcohol, and a form of aluminum which is soluble in water or alcohol (claim 42);
- c) disclose introducing an atomizing gas through the nozzle to the vicinity of the flame;
- d) disclose atomizing the second glass component in the vicinity of the flame; or
- e) disclose producing glass particles containing a rare earth metal.

Looking to the secondary references that have been cited, only Takahashi concerns a flame hydrolysis method for making glass particles. However, Takahashi does not fill the gaps in Randall. Referring to FIGs. 3 and 4 and the accompanying text of Takahashi, a multi-conduit burner 31 introduces a gaseous glass raw material (such as  $\text{SiCl}_4$  carried by argon gas) through one conduit, and a nebulized metal salt solution through another conduit, as well as fuel (e.g. hydrogen) and oxygen gases through other conduits. Takahashi does not combine a separate gas or vapor glass feedstock with a liquid glass component feedstock that includes a rare earth metal. Takahashi has a separate dopant solution devoid of glass component. Nor does Takahashi include a rare earth metal as dopant.

As discussed above, applicants disagree that the disparate teachings of Hawtof and Ainslie properly are combined with teachings for flame hydrolysis methods, such as Randall and/or Takahashi. Randall and Takahashi start with halide-containing glass components, which Hawtof expressly seeks to avoid. Randall and Takahashi use “vaporous reactants”, where Hawtof directs use of siloxane in liquid feedstock form. Because siloxane behaves differently than silicon tetrachloride, one of ordinary skill in the art would not seek to combine Hawtof with Randall or Takahashi to arrive at the claimed method.

With respect to pending claim 44, Hawtof also fails to disclose delivering the first and second glass components (as interpreted by the Examiner) through separate tubes within a single multi-conduit nozzle. Therefore, combining the disclosures of Hawtof and Randall does not result in a teaching of delivering first and second glass components through separate tubes, as presently claimed.

Moreover, as discussed above, Ainslie represents an entirely different glass forming technology — MCVD, which is not based on flame hydrolysis and does not direct glass components and atomizing gases through a nozzle to a flame. Ainslie shows that erbium chloride (not erbium nitrate) can be doped into SiO<sub>2</sub> formed by an MCVD process using SiCl<sub>4</sub> and other glass components that includes immersing the porous glass in a solution that contains the erbium chloride. Ainslie does not use a flame method. So, Ainslie does not teach or suggest anything with respect to whether flame sprayed glass particles can be doped with erbium or other rare earth metals.

In summary, the Examiner has not made out a *prima facie* case of obviousness because the references taken as a whole cannot be combined in the manner proposed by the Examiner. There is no teaching, suggestion or motivation to make the combination proposed by the Examiner in view of the distinct differences between the methods disclosed in the references, and the specific teachings (particularly in Hawtof) that would direct skilled persons away from making such combination. Second, even if the combination were attempted, the invention as claimed would not result. None of the

references show a flame hydrolysis method in which a second glass component that includes a rare earth metal is introduced in atomized liquid form through the same nozzle as the fuel gas to a flame. This method step in combination with the other method steps of the pending claims represents an advance in producing homogeneous multicomponent glass particles.

Claims 37 to 45 distinguish over the art and should be allowed.

***Rejection of claims 46-52 based on of Randall, Hawtof, Ainslie, Takahashi and Finnish Patent 98832***

Applicants respectfully request reconsideration and withdrawal of the rejection of claims 46-52 under 35 U.S.C. §103(a) as being unpatentable over Randall in view of Hawtof, Ainslie, Takahashi and Finnish patent 98832 (FI '832).

The Examiner stated that claims 46-52 are substantially the same as claims 37-45, except that claims 46-52 require that a fuel gas be used to cause atomizing of the second glass component. The Examiner asserted that FI '832 discloses the use of fuel gas as an atomizing gas.

FI '832 does teach that a fuel gas may be used as an atomizing gas in a flame hydrolysis method. However, FI '832 does not fill the gaps in the disclosures of Randall, Hawtof, Ainslie and Takahashi that were identified in response to the rejection of claims 37-45. FI '832 does not show a flame hydrolysis method in which a second glass component that includes a rare earth metal is introduced in atomized liquid form through the same nozzle as the fuel gas to a flame. FI '832 does not concern multicomponent glass particles. FI '832 simply does not address making homogeneous multicomponent glass particles that incorporate rare earth metals. Therefore, for the same reasons that claims 37 to 45 are allowable, claims 46-52 are allowable.

***Conclusion***

In view of the above amendment, applicants believe the pending application is in condition for allowance.

Enclosed is a Petition for a One-Month Extension of Time. Applicants believe no other fee is due with this response. However, if another fee is due, please charge our Deposit Account No. 22-0185, under Order No. 20386-00294-US from which the undersigned is authorized to draw.

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Respectfully submitted,



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Enclosure – Petition for One-Month Extension  
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